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Clinics in Diagnostic Imaging (32)

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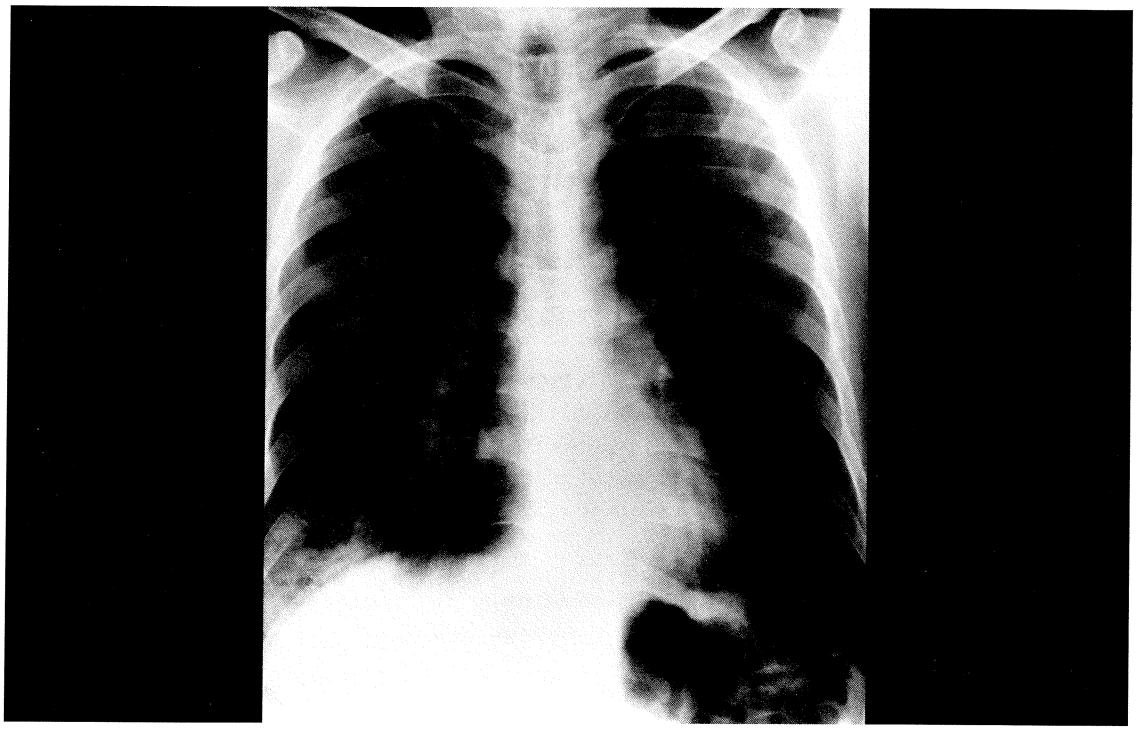

Fig 1 – Frontal chest radiograph

CASE REPORT

A 24-year-old Thai man presented with a 2-month history of productive cough. He had associated fever. He was known to be seropositive for the human immunodeficiency virus-I (HIV) for five months. On ausculation of his chest, there were decreased breath sounds in the right lung base. What does the chest radiograph (Fig 1) show?

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Table I - Relationship between radiographical pulmonary parenchymal pattern and CD4 lymphocyte count in HIV-infected patients

	CD4 lymphocyte count (in cells/mm³)				
Radiographic pattern	**Any count**	**Above 200**	**Below 200**	**Below 100**	**Below 50**
Cavitary consolidation	Bacterial pneumonia	*Mycobacterium TB* re-infection			*Rhodococcus equi* *Nocardia asteroides*
Focal consolidation		Bacterial pneumonia eg. *Streptococcus pneumoniae* *Haemophilus influenzae*	*Mycobacterium TB* (primary pattern)		Fungal infection lymphoma (less common)
Miliary interstitial infiltrates	Miliary TB			Fungal pneumonia eg. *Cryptococcus neoformans*	
Reticular interstitial infiltrates	AIDS-related cardiomyopathy and nephropathy		*PCP*		
Nodular pattern					*CMV* pneumonitis *MAI* infection Fungal infection *Mycobacterium TB* Kaposi sarcoma

[Table adapted from reference no. 3]

IMAGE INTERPRETATION

The chest radiograph (Fig 1) shows patchy consolidation in the lower zone of the right lung. There are small areas of cavitation within it. Appearances are that of a cavitary pneumonia.

DIAGNOSIS

Opportunistic pneumonia in acquired immunodeficiency syndrome (AIDS)

CLINICAL COURSE

Modified acid-fast stains of the patient's sputum confirmed the diagnosis of *Nocardia*. Conventional acid-fast stains were negative. The patient was treated with a course of oral trimethoprim-sulfamethoxazole, with subsequent improvement. Repeat chest radiograph showed complete lesion resolution (Fig 2).

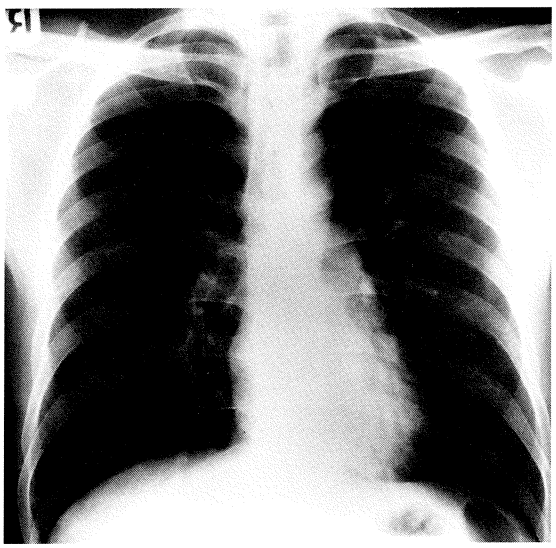

Fig 2 – Follow-up chest radiograph shows complete resolution of the *Nocardia* pneumonia

DISCUSSION

Patients with HIV infection are prone to development of a variety of malignancies and opportunistic infections. Pulmonary disease occurs in up to 90% of patients infected with HIV at some time during the course of their illness[1]. The differential diagnosis of an AIDS patient presenting with clinical and/or radiographical features of pulmonary disease is however very wide. Recognition of the dominant radiographical pattern of a pulmonary process is helpful in formulating an accurate short list of differential diagnoses[2]. Frequently described pulmonary parenchymal patterns are cavitary consolidation, focal consolidation, miliary interstitial infiltrates, reticular interstitial infiltrates and nodular pattern. It has recently been proposed that knowledge of the patient's CD4 lymphocyte count, a marker of immunocompetence level, contributes to increased likelihood of a given diagnosis when correlated with the radiographical appearance[3].

Bacterial pneumonia and *Mycobacterium tuberculosis (TB)* are frequently-encountered pulmonary infections in AIDS patients. Radiographically, they are usually seen as cavitary and non-cavitary consolidations, and are found in patients with CD4 lymphocyte counts greater than 200 cells/mm³. With CD4 lymphocyte counts of less than 50 cells/mm³, unusual bacterial infections, such as *Rhodococcus equi* and *Nocardia asteroides*, should be considered in the presence of a cavitary consolidation. As CD4 lymphocyte counts fall below 200 cells/mm³, the prevalence of *Pneumocystis carinii pneumonia (PCP)* and disseminated fungal infections increases, and should be suspected when interstitial infiltrates are present. The combination of a radiographical nodular or reticular pattern, and CD4 lymphocyte counts of below 50 cells/mm³ in

Table II - Important causes of cavitary infiltrates in HIV-infected patients

Organism	Comments
I. Mycobacteriae infections:	
Mycobacterium TB	Reactivation or post-primary TB. Common infection. Frequently cavitate.
Mycobacterium kansii	Frequently cavitate.
II. Bacterial infections:	
Any gram-negative organism	May caviate.
Pseudomonas aeruginosa	)
Nocardia asteroides	) Increasingly recognised. Frequently cavitate.
Rhodococcus equi	)
III. Fungal infections:	
Invasive pulmonary aspergillosis (*Aspergillus* species)	Increasingly recognised. Frequently cavitate.
IV. Protozoal infections:	
Pneumocystis carinii	Common infection. Infrequently cavitate.
V. Non-infectious lesions:	
Kaposi sarcoma	) Rarely cavitate.
Non-Hodgkin's lymphoma	)

[Table adapted from reference no. 4]

a patient with advanced AIDS should suggest the possibility of AIDS - related lymphoma, *Cytomegalovirus (CMV)* pneumonia and *Mycobacterium avium - intracellulare (MAI)* infection [3]. These features are summarised in Table I.

Cavitation within a pulmonary lesion is the end-result of a pathological process which has led to tissue necrosis. As a pulmonary cavity is an intra-lesional gas-filled space produced by expulsion of a portion of the lesion through the bronchial tree, it is rarely detectable by physical examination and is usually initially demonstrated on chest radiographs. Radiographical features such as location, shape, size, wall thickness, presence or absence of fluid and other contents, presence of satellite lesions, and appearance of surrounding lung parenchyma, may be helpful in determining the cause[4]. Although cavitary lesions in immunocompromised patients may be caused by non-infectious conditions such as neoplasms, collagen-vascular diseases and pulmonary emboli with infarction, most of these pulmonary cavities result from opportunistic infections. The importance of being able to recognise some of these opportunistic infections is that most of them are potentially treatable (Table II).

The AIDS epidemic has led to an increased incidence of TB worldwide. *Mycobacterium TB*, being more virulent than most other HIV-associated opportunistic organisms, often causes disease at an earlier stage of HIV infection and may indeed be initial manifestation of AIDS[5]. The clinical and radiographical features of TB depend on the degree of the patient's state of immunosuppression. Reactivated TB tends to affect patients with mild-to-moderate depression of CD4 lymphocyte count (over 200 cells/mm^3). Radiographically, cavitary infiltrates are present in the apical and posterior segments of the upper lobes, and the superior segments of the lower lobes, similar to typical post-primary TB[6]. Multidrug-resistant TB has emerged in recent years and these strains have been found to be more likely to produce alveolar infiltrates and cavities[1]. *MAI* is an uncommon cause of pulmonary cavities in AIDS

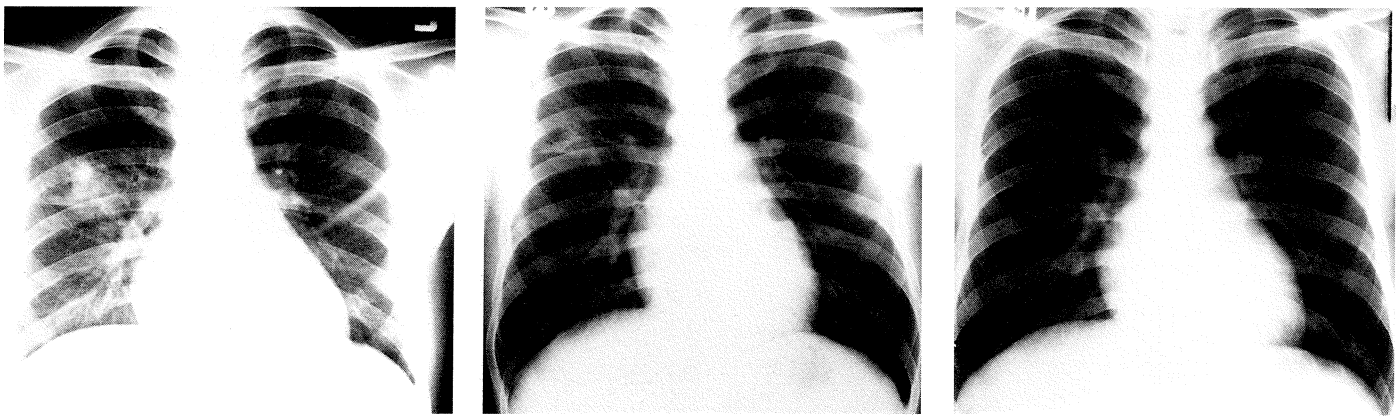

Fig 3a Fig 3b Fig 3c

Fig 3 – 28-year-old man with pulmonary *Nocardiosis* complicating HIV infection. (a) Initial radiograph shows a right upper lobe infiltrate. Repeat radiographs after (b) 10 days and (c) 6 weeks, show progressive resolution of the lesion. He was treated with trimethoprim-sulfamethoxazole

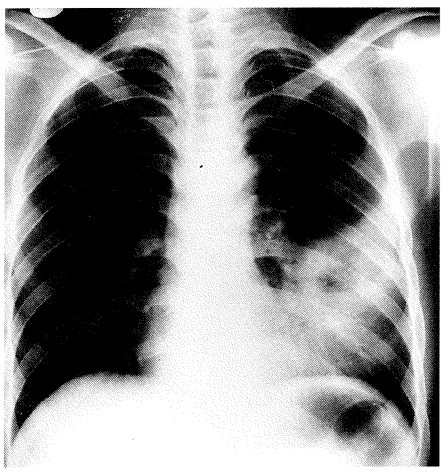

Fig 4a

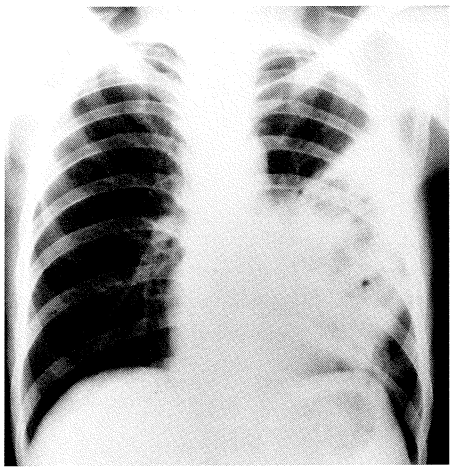

Fig 4b

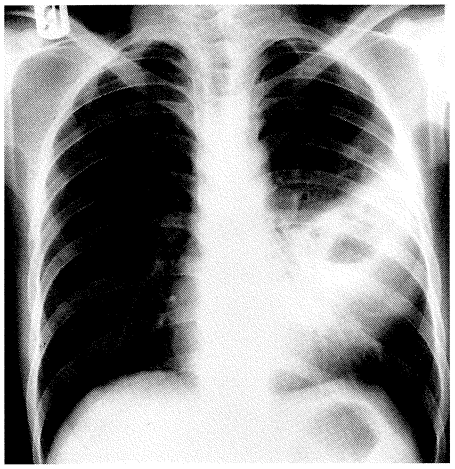

Fig 4c

Fig 4 – 30-year-old man with HIV infection and progressive *Rhodococcus equi* pneumonia. Serial radiographs (a), (b) and (c) show worsening of the cavitary pneumonic infiltrates in the left lower lung

while *Mycobacterium kansaii* is often associated with cavitation in patients with advanced HIV infection[4].

HIV-infected patients are prone to community-acquired bacterial pneumonia from organisms such as *Streptococcus pneumoniae* and *Haemophilus influenza*[8]. These more common infections however rarely produce cavitation. Cavitary infiltrates have been increasingly recognised in *Pseudomonas aeruginosa* pneumonia[9], and in nosocomial pneumonia caused by other gram-negative bacilli and by *Staphylococcus aureus*[4]. In patients with advanced immunodeficiency (low CD4 lymphocyte counts of less than 50 cells/mm^3), cavitary pneumonia due to unusual bacteria such as *Nocardia asteroides* and *Rhodococcus equi* should be considered. *Nocardia* is an aerobic gram-positive actinomycete which, being a soils saprophyte, is an uncommon human pathogen. Infected patients usually present indolently with non-specific constitutional symptoms, dyspnoea or cough. Radiographically, alveolar infiltrates are commonly seen in *Nocardia* pneumonia, with cavitation being a prominent feature[10]. Conventional acid-fast stains often do not stain *Nocardia*, therefore modified acid-fast stains are required for diagnosis. The treatment of choice is trimethoprimsulfamethoxazole (Fig 3).

Rhodococcus equi is an aerobic gram-positive bacillus which is a major cause of pneumonia in horses, cattle, pigs, and other domestic animals. In the past decade, the incidence of this infection has been increasing in immunocompromised patients, owing largely to the HIV epidemic. It occurs in the more advanced stages of immunodeficiency, ie. with CD4 lymphocyte counts of 50 cells/mm^3 or less. The clinical presentation of *Rhodococcus equi* pneumonia is typically subacute, with fever, cough, chest pain, fatigue and weight loss. Pulmonary lesions affect both the upper and lower lobes, with cavitation, pleural effusion and empyema being frequent features (Fig 4). Computed tomography may show mediastinal lymphadenopathy. This infection usually responds poorly to conventional antibiotic therapy and in-vitro investigation of the serum bactericidal activity of drug combinations has been recommended[11-15].

Fungal infections such as cryptococcosis, coccidioidomycosis and histoplasmosis rarely cause cavitary pneumonia. It is however a frequent finding in invasive pulmonary aspergillosis[16]. Although cavitation is an uncommon manifestation of *Pneumocystis carinii* pneumonia (PCP), this infection should always be considered as it remains the most common serious opportunistic infection in HIV-infected patients. Radiographically, diffuse bilateral reticular interstitial infiltrates are the most frequent manifestation. Atypical patterns such as localised alveolar infiltrates, cystic or honeycomb lesions, spontaneous pneumothoraces and hilar enlargement may be seen (Fig 5). These atypical radiographic patterns, including cavitary lesions, appear to be associated with the use of aerosolised pentamidine prophylaxis[4, 7-20]. As the presence of a cavitary lesion and/or use of aerosolised pentamidine have been associated with lower diagnostic yields of induced sputum specimens and bronchoalveolar ravage (BAL), transbronchial biopsy may be needed for the diagnosis of *PCP*[19-21].

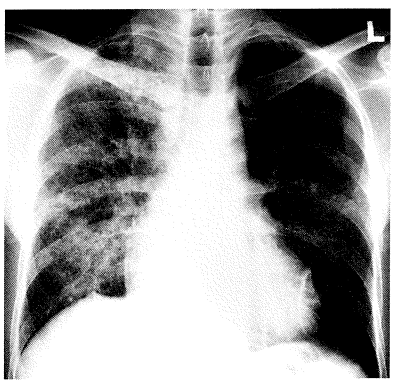

Fig 5a

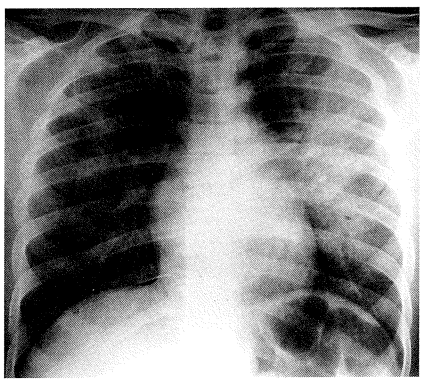

Fig 5b

Fig 5 – Chest radiographs of 2 different AIDS patients with typical patterns of *PCP*. (a) 37-year-old man with diffuse reticular infiltrates, much worse in the right lung. (b) 28-year-old man with reticular infiltrates in the right lung and alveolar infiltrates in the left lung

In summary, recognition of the dominant radiographical pulmonary parenchymal pattern and the correlation of these patterns to the patients' level of immunocompetence are helpful in limiting the differential diagnosis in HIV-infected patients. In addition to sputum examination, further studies such as computed tomography, BAL, and transbronchial or percutaneous biopsy may be required. A specific diagnosis should be aimed for in HIV-infected patients, to ensure appropriate treatment of curable opportunistic infections.

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ABSTRACT

A 24-year-old HIV-positive patient presented with fever and productive cough. Chest radiograph showed a cavitating pulmonary infiltrate. Diagnosis of Nocardosis was made from modified acid-fast stain of his sputum specimen. He responded well to antibiotics. The radiographic patterns of opportunistic infection in patients with AIDS, with emphasis on cavitary pneumonia, is discussed.

Keywords: acquired immunodeficiency syndrome (AIDS); human immunodeficiency virus (HIV); lung infections; *Nocardia; Pneumocystis carinii; Rhodococcus*